DIVERSITY, PHENOLOGY, AND FLOWER HOSTS OF ANTHOPHILOUS LONG-HORNED BEETLES (COLEOPTERA: CERAMBYCIDAE) IN A SOUTHEASTERN OHIO FOREST[1]

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ABSTRACT: A total of 1523 anthophilous Cerambycidae in Washington County, Ohio, were recorded over four field seasons (1995-1998) and included 22 genera and 28 species. The most commonly used inflorescenses were those of goatsbeard (*Aruncus dioicus* [Walt.]) and wild hydrangea (*Hydrangea arborescens* L.) in June through mid-July and queen anne's lace (*Daucus carota* L.) in late July. *Judolia cordifera, Metacmaeops vittata, Strangalepta abbreviata* and two species of *Brachyleptura* preferentially feed upon goatsbeard and wild hydrangea. For the seven most abundant beetle species, there is a positive correlation between the number of plant species used and both the number of individuals of lepturine species and the length of their activity period, indicating that species which are common or have long seasonal phenologies use blossoms of many different plant species. At the most diverse site (Reas Run), the greatest number of species (16) was recorded in the third week of June while the greatest number of individuals (118, although only two species) was observed during a week in mid-July. The most abundant species was *Typocerus velutinus* accounting for 31% of the observations. *Analeptura lineola, Strangalepta abbreviata* and two species of *Brachyleptura* accounted for an additional 49.5% of the observations. The average length of adult activity on flowers (in species where a minimum of 10 individuals were collected) is 5.2 weeks, and the average number of plant species used is 9.38 with a maximum of 16 for *T. velutinus*.

Flower feeding or anthophilous Cerambycidae belong mainly to the subfamily Lepturinae, with smaller numbers in the Cerambycinae and fewer still in the Lamiinae. The majority of adults frequent blossoms where they gather to feed on flower parts and nectar (Linsley, 1959; Linsley and Chemsak, 1972). The sexes also locate each other and mate on flowers, with females, in most species, later flying off to oviposit in dead wood (Linsley and Chemsak, 1972). Although most anthophilous cerambycids use a variety of blossoms, some species are known to be quite specific. For example, Gorman (1921) discussed the close association of adults of *Megacyllene robiniae* (Forster) (Cerambycinae) with goldenrod (*Solidago* spp.), and Linsley (1957) and Linsley and Chemsak (1961) noted that adults of the genus *Crossidius* (Cerambycinae) usually frequent the blossoms of their larval host plants, where they mate and feed on pollen. Most lepturines do not use the flowers of their larval host plants and, in general, a wide variety of species may be found on any particular inflorescence. Knull (1946), though, does imply that several species have preferred flower hosts.

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The Lepturinae are known primarily as a northern hemisphere group. This distribution is illustrated within the United States. While the fauna of the northern Appalachians may be one of the most diverse, those more southern become progressively depauperate. For example, Ohio has nearly 70 species (Knull 1946, Keeney, pers. com.), north-central Texas only 14 species (Lingafelter and Horner, 1993), while southern Texas drops to four species (Hovore et al., 1987).

Although most students have a sense of which cerambycids are common or rare and the best flowers for collecting specimens, there are only a few long-term studies that actually document relative abundance, phenology, and flower preference of anthophilous species. Gosling (1986) studied the cerambycid fauna of northern Michigan and recorded species abundance (as common, frequent, occasional, or rare), phenology, larval hosts, and flower records. Gardiner (1970) noted flower records and phenology of lepturines from Ontario, western Quebec, and Alberta but without any precise information on numbers of individuals or sometimes even the species of plant blossoms used. Linsley and Chemsak (1972, 1976) recorded flower hosts for all species treated in their monographs of the Lepturinae of North America. Terron (1991) surveyed the cerambycid fauna of a preserve in Durango, Mexico and reported the phenology of 22 species. One other more inclusive study was that of Kakutani et al. (1990) where the seasonal pattern of insect visits to flowers was studied, although Cerambycidae were rare at their study site.

The Lepturinae in Ohio present a unique opportunity to study the diversity of a group of insects; species richness is high, the group is taxonomically well known, many species are diurnally active on blossoms, and individuals are relatively large and often distinctly colored and shaped, making identification easy. Here we report on the diversity and phenology of cerambycids found on flowers in a mixed Appalachian forest in southeastern Ohio. The species, numbers of individuals, and their flower hosts were recorded over a period of four years from early May through late July. Rather than collecting all individuals, most specimens were observed on the flowers and left undisturbed. We also attempted to determine if flower preferences exist in any of the species we observed.

MATERIALS AND METHODS

The study site was located at Reas Run (also known as Scotts Run), Washington County, Route 14, Ohio (39° 26' 21" N, 81° 10' 19" W), located approximately due east of Marietta near the Ohio River. The area is a completely forested ravine except for open edges averaging five meters in width adjacent to a narrow, paved, two-lane road, where most of the flowering plants are located.

The vegetation is typical of a relatively diverse mixed mesophytic forest

(Braun 1950) and is part of the unglaciated Allegheny Plateau (Braun 1961). The most abundant tree species include white and black oaks (*Quercus* spp.), maple (*Acer* spp.), beech (*Fagus grandifolia* Ehrh.), tulip poplar (*Liriodendron tulipifera* L.), sycamore (*Platanus occidentalls* L.), black locust (*Robinia pseudo-acacia* L.), sassafras (*Sassafras abidum* [Nutt.] Nees), virginia pine (*Pinus virginiana* Mill.), ironwood (*Carpinus caroliniana* Walt.), hickory (*Carya* spp.), dogwood (*Cornus* spp.), witchhazel (*Hamamelis virginiana* L.), and alder (*Alnus serrulata* [Alt.] Willd.). Shrubs include staghorn sumac (*Rhus typhina* L.), elderberry (*Sambucus canadensis* L.), and spice-bush (*Lindera benzoin* [L.]).

Nearly 800 meters of forest and road edges were surveyed for the presence of cerambycids on flowers. Beetles were observed from the beginning of May (as early as May 3) through the end of July (as late as July 25). Since the time of day and air temperature affect the activity of these diurnal beetles, all counts were made between 11:00 A.M. and 5:00 P.M. Each visit took from two to three hours. Data were collected from 1995 through 1998. Several other localities within Washington County were also periodically visited to assess more accurately the diversity of cerambycids and their flower hosts in this area.

All flowers were approached with caution to avoid alarming beetles and causing them to take flight. Due to the steepness of some of the terrain, relatively inaccessible flowers were censused with binoculars. The species, numbers of individuals, and the host flowers, were recorded. Voucher specimens (deposited in the TKP collection) were collected on several occasions, photographs were also taken, and identifications verified in the laboratory. All individuals were recorded to species except for two species of *Brachyleptura, B. champlainii* Casey and *B. rubrica* (Say), due to some difficulty in accurate identification (from similar color and morphology). Specimens of the cryptic *Typocerus deceptus* Knull may also have been recorded as *T. velutinus* although the former species is uncommon (Knull, 1946). One final species, *Grammoptera haematites* (Newman) typically has a red pronotum but rarely may be all black; hence it possibly could be misidentified as *G. subargentata* (Kirby). Since all individuals observed were generally not collected, there is a possibility that some individuals were recorded twice. We think this risk is minimal due to the minimum four day (but usually at least one week) spacing of visits and the relatively short lifespan of the adults (Linsley, 1961).

No attempt was made to quantify the abundance of various blossoms, due to the difficulty in comparing the different inflorescence forms as, for example, goatsbeard (a dioecious plant with small flowers in narrow elongated, spike-like clusters) and queen anne's lace (an umbel with broad clusters of flowers). We concentrate our discussion only on the seven most abundant species in Reas Run, as observations on other taxa are so few as to

be potentially misleading. Statistics were performed using SYSTAT (version 5.0).

RESULTS AND DISCUSSION

Host flowers of Lepturinae and Cerambycinae in Washington County, Ohio are as follows, with new records (those not recorded in Linsley and Chemsak [1972, 1976] and Gosling [1986]) marked with an asterisk:

Lepturinae

Analeptura lineola: Appendaged waterleaf* (*Hydrophyllum appendiculatum* Michx.), blackberry (*Rubus* sp.), blue phlox* (*Phlox divaricata* L.), common fleabane* (*Erigeron philadelphicus* L.), cow parsnip* (*Heracleum lanatum* Michx.), dame's rocket* (*Hesperis matronalis* L.), false solomon's seal (*Smilacina racemosa* [L.]), wild geranium* (*Geranium maculatum* L.), goatsbeard (*Aruncus dioicus* [Walt]), sweet cicely* (*Osmorhiza claytoni* [Michx.]), water-hemlock* (*Cicuta maculata* L.), wild hydrangea (*Hydrangea arborescens* L.).

Brachyleptura vagans (Oliv.): Smooth sumac* (*Rhus glabra* L.), queen anne's lace* (*Daucus carota* L.)

Brachyleptura spp. (*champlaini* Casey or *rubrica* [Say]): Common elderberry (*Sambucus canadensis* L.), cow parsnip*, goatsbeard, pasture rose* (*Rosa carolina* L.), queen anne's lace*, smooth sumac, water-hemlock*, wild hydrangea, yarrow* (Achillea millefolia L.).

Brachysomida bivittata (Say): Appendaged waterleaf*, blackberry*, common fleabane*, goatsbeard*, multiflora rose* (*Rosa multiflora* Thunb.), ox-eye daisy* (*Chrysanthemum leucanthemum* L.), wild geranium, wild hyacinth* (*Camassia scilloides* [Raf.] Cory).

Charisalia americana (Hald.): Cow parsnip*.

Grammoptera haematites (Newman): Goatsbeard, wild geranium*, wild hydrangea*

Grammoptera subargentata (Kirby): Cow parsnip, goatsbeard, wild hydrangea.

Gaurotes cyanipennis (Say): Wild hydrangea*

Judolia cordifera (Oliv.): Common elderberry, goatsbeard*, ox-eye daisy*, queen anne's lace, smooth sumac*, wild hydrangea, yarrow*.

Leptura subhamata Rand.: Cow parsnip*, goatsbeard*, water-hemlock*, wild hydrangea.

Metacmaeops vittata (Swederus): Cow parsnip*, dogbane* (*Apocynum* sp.), goatsbeard, smooth sumac*, water-hemlock*, wild hydrangea.

Pseudostrangalia cruentata (Hald.): Cow parsnip*, goatsbeard*.

Strangalepta abbreviata (Germar): Blackberry, black cohosh* (*Cimicifuga racemosa* Nutt.), cow parsnip*, goatsbeard, multiflora rose, pasture rose, queen anne's lace*, wild hydrangea.

Strangalepta pubera (Say): Cow parsnip*, goatsbeard, wild geranium*, wild hydrangea*, yarrow.

Strangalia bicolor (Swed.): Wild hydrangea.

Strangalia luteicornis (Fab.): Black cohosh*, butterfly-weed* (*Asclepias tuberosa* L.), common milkweed* (*Asclepias syriaca* L.), goatsbeard*, pasture rose, queen anne's lace, water-hemlock*, wild hydrangea, yarrow*.

Strophiona nitens (Forst.): Goatsbeard.

Trigonarthris proxima (Say): Goatsbeard, wild hydrangea.

Typocerus acuticauda Casey: Queen anne's lace*, tall meadow rue* (Thalictrum polygamum Muhl), water-hemlock*, white snakeroot* (*Eupatorium rugosum* L.), wild hydrangea*.

Typocerus lugubris (Say): Goatsbeard*, smooth sumac*, wild hydrangea.

Typocerus velutinus: American bellflower* (*Campanula americana* L.), black cohosh*, common elderberry, common fleabane*, common milkweed, narrow-leaved mountain mint* (*Pycnathemum tenuifolium* Schrad.), ox-eye daisy*, queen anne's lace, swamp milkweed (*Asclepias incarnata* L.), teasel* (*Dipsacus sylvestris* Huds.), tall meadow rue*, water-hemlock*, white wood aster* (*Aster divaricatus* L.), wild hydrangea, wild bergamot* (Monarda fistulosa L.), yarrow*.
Xestoleptura octonotata (Say): Goatsbeard, wild hydrangea.

Cerambycinae

Callimoxys sanguinicollis (Oliv.); Cow parsnip.
Clytus ruricola (Oliv.): Wild hydrangea.
Cyrtophorus verrucosus (Oliv.): Cow parsnip.
Euderces picipes (Fab.): Cow parsnip, goatsbeard, smooth sumac, wild hydrangea.
Molorchus bimaculatus Say: Goatsbeard*.
Rhopalophora longipes (Say): Wild hydrangea.

The vegetation in Reas Run is quite diverse, supporting numerous species of deciduous and coniferous trees, various shrubs, and forbs. Although 68 lepturine species have been recorded in Ohio (Knull 1946, Keeney, pers. com.), eliminating single state records and nocturnally active species reduces the total to around 36 flower feeding species (Androw, pers. com.). Regardless, we observed only 18 species and 14 genera of lepturines in Reas Run (Table 1) (and 22 species and 16 genera in Washington County) over four years. Compared to our results, even lower diversity in the forest canopy was found by Krinsky and Godwin (1996), who recorded 16 species of lepturines from fogging samples in a five year survey of the northeastern United States. In northern Michigan, Gosling (1986) recorded 34 species of lepturines in 27 genera, but only 16 species were collected on flowers, undoubtedly due to extensive rearing of larval infested wood and perhaps greater influence of the boreal forest element. Not unexpectedly, we also observed six species of anthophilous cerambycines: three in Reas Run; *Euderces picipes* (Fab.), *Molorchus bimaculatus* Say, and *Rhopalophora longipes* (Say) and three more within Washington County; *Callimoxys sanguinicollis* (Oliv.), *Clytus ruricola* (Oliv.), and *Cyrtophorus verrucosus* (Oliv.).

There are several species of lepturines which we did not expect to find because of their rarity, nocturnal activity, or records only from the northern part of Ohio, such as *Leptorhabdium picta* (Hald.) or *Cosmosalia chrysocoma* (Kirby). But others, such as the relatively common *Pidonia* spp., *Trachysida mutabilis* (Newman), *Strangalia acuminata* (Oliv.), or some *Stenocorus* spp., were absent even though the recorded larval and adult food plants are present and the site is within the known distributions.

Gosling (1986) suggests that anthophilous beetles may have relatively little choice of blossoms in northern Michigan, and may have to use flowers

Table 1. Anthophilous Cerambycidae observed in 30 visits to Reas Run, 1995-1998. *Brachyleptura champlainii* and *B. rubrica* are combined under their generic name.

Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul	Total	% of Total	# Weeks Seen
Brachysomida bivittata	1	8	19	27	2	4	1						62	4.1	7
Analeptura lineola	3	1		10	39	40	76	25	14	7			215	14.2	9
Grammoptera haematites			2		5		1	3					11	0.73	4
Strangaleptura pubera			2	3	8		1						14	0.92	4
Metacmaeops vittata					6	3	7	11	32				59	3.9	5
Strangalepta abbreviata					27	18	106	28	8	13			200	13.21	6
Brachyleptura spp.					19	16	187	94	10	8			334	22.06	6
Judolia cordifera						4	42	28	7	4			85	5.61	5
Trigonarthris proxima						1	3	1					5	0.33	3
Typocerus lugubris							2	2					4	0.26	2
Leptura subhamata							4	7					11	0.73	2
Strangalia luteicornis							1	10	7	10	9	3	40	2.64	6
Xestoleptura octonotata							2						2	0.13	1
Strophiona nitens							1						1	0.07	1
Typocerus velutinus							16	17	103	123	109	106	474	31.31	6
Gaurotes cyanipennis									1				1	0.07	1
Typocerus acuticauda										2		2	4	0.26	2
*Euderces picipes**								6		4			10	0.66	2
*Molorchus bimaculatus**							1						1	0.07	1
*Rhopalophora longipes**								1					1	0.07	1
Total	4	9	23	40	106	86	450	226	182	167	118	111	1522		
# Visits, 1995-1998	2	2	2	2	2	2	5	3	3	3	1	3	30		
Average number / visit	2	4.5	11.5	20	53	43	90	75.3	60.7	55.7	118	37	50.7		

*Cerambycine – all others are Lepturinae.

they seldom visit in other areas. With the greater blossom diversity in Reas Run, lack of choice is probably not as pronounced. Knull (1946) implies that several species (e.g., *Strangalia bicolor* (Swed.) and *Stenocorus vifflger* (Rand.) do have flower preferences. McDowell (1990) also collected *T. deceptus* (n=31) throughout June and July, but only on wild hydrangea flowers. We also note preferences in the abundant *Judolia cordifera, Metacmaeops vittata, Strangalepta abbreviata, Strangalia luteicornis* and *Brachyleptura* spp.; specimens were found only on goatsbeard and wild hydrangea blossoms in Reas Run, in contrast to the other species listed in Table 2. It could be argued that flower selectivity may be due to the relative abundances of goatsbeard and wild hydrangea in this area, since other plant species were low in numbers. But with the numbers of beetles observed only on these plants (467 individuals), we think this is unlikely. Additionally, even though queen anne's lace is as available during much of the time as wild hydrangea, the former is not used until the latter is no longer flowering. Where goatsbeard and wild hydrangea are absent though, these same lepturines, in lower numbers, were located on several different, and perhaps less desirable, hosts.

The average activity period in Reas Run (for 12 species, where a minimum of 10 individuals were collected) is 5.2 weeks and the average number of plant species visited is 9.38. *Analeptura lineola* had the longest activity period and was recorded for 10 weeks (Table 2). In six weeks, *Typocerus velutinus* was recorded from the greatest number of plant species blossoms (16), including nine species in Reas Run and an additional seven in the surrounding areas of Washington County. Our ranges of adult activity (Table 2) are probably longer than in a typical year for most species (except for *S. luteicornis* and *T. velutinus* which were still present at the end of July), due to variance in annual phenologies over the four year recording period. Regression analyses of the seven most abundant species were done (except for *Brachyleptura* spp.). A correlation was found between the numbers of adults seen and diversity of flower hosts used ($p = 0.006$) (Fig. 1). There may also be a correlation between the length of the activity period and diversity of flower hosts. Although the p-value was not significant (0.343), the correlation is significant ($p = 0.028$) if the length of activity of *T. velutinus* is increased by two weeks (Fig. 2). Although *T. velutinus* was recorded for only six weeks to the end of our study period (July 25), it is usually present in the area until at least early or mid-August, an additional two or three weeks. These analyses may indicate that some species of lepturines are not very selective in their choice of flower host and can use many types of blossoms for a food source and mating substrate. It is also intuitive, though, that with longer seasonal activity periods of a beetle species, more varieties of blossoms will have to be used, since flowering phenology of many plant species is often relatively short. Perhaps part of the reason for numerical success of

Table 2. Adult flower host presence (——), date of appearance and the number of individuals of lepturines per collection week, 1995-1998, Reas Run, Washington County, Ohio.

Typocerus velutinus (Oliv.)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Wild Hydrangea	*Hydrangea arborescens*							16	17	101	117	108	22
Tall Meadow Rue	*Thalictrum polygamum*									2	2		
Yarrow	*Achillea millefolia*						——	——	——	——	3	——	1
Ox-Eye Daisy	*Chrysanthemum leucanthemum*						——	——	——	——	1		
American Bellflower	*Campanula americana*									——	——	1	——
Queen Anne's Lace	*Daucus carota*									——	——	——	68
Common Milkweed	*Asclepias syriaca*									——	——	——	10
Black Cohosh	*Cimicifuga racemosa*											——	4
Aster	*Aster* sp.												1
Brachyleptura spp.*	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Goatsbeard	*Aruncus dioicus*					19	16	177	56	——	1		
Wild Hydrangea	*Hydrangea arborescens*							10	37	10	7	——	——
Analeptura lineola (Say)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
False Solomon's Seal	*Smilacina racemosa*	3	1	——	7	——	11						
Wild Geranium	*Geranium maculatum*	——	——	——	1								
Appendaged Waterleaf	*Hydrophyllum appendiculatum*	——	——	——	1								
Blackberry	*Rubus* sp.	——	1										
Goatsbeard	*Aruncus dioicus*					39	29	79	13	——	——		
Poison Hemlock	*Conium maculatum*					——	——	1					
Wild Hydrangea	*Hydrangea arborescens*							——	12	14	7	——	——

*Cerambycine – all others are Lepturinae.

Table 2, continued

Strangalepta abbreviata (Germ.)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Goatsbeard	*Aruncus dioicus*					27	18	85	5	—	—		
Wild Hydrangea	*Hydrangea arborescens*							21	23	8	13	—	—
Judolia cordifera (Oliv.)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Goatsbeard	*Aruncus dioicus*					—	4	38	18	3	—		
Wild Hydrangea	*Hydrangea arborescens*							6	10	4	4	—	—
Metacmaeops vittata (Swed.)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Goatsbeard	*Aruncus dioicus*					6	3	7	—	—	—		
Wild Hydrangea	*Hydrangea arborescens*							—	11	32	—	—	—
Brachysomida bivittata (Say)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Wild Geranium	*Geranium maculatum*	1	8	19	23								
Multiflora Rose	*Rosa multiflora*				1	2							
Common Fleabane	*Erigeron philadelphicus*	—	—	—	1	—	2	—	—	—			
Blackberry	*Rubus* sp.			—	2								
Goatsbeard	*Aruncus dioicus*				—	1	1	—	—	—			
Appendaged Waterleaf	*Hydrophyllum appendiculatum*	—	—	—	—	—	1						
Strangalia luteicornis (F.)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Goatsbeard	*Aruncus dioicus*					—	—	1	1	3	2		
Wild Hydrangea	*Hydrangea arborescens*							—	9	4	8	9	—
Queen Anne's Lace	*Daucus carota*							—	—	—	1		
Tall Meadow Rue	*Thalictrum polgamum*										—	—	1
Common Milkweed	*Asclepias syriaca*									—	—	—	1

some species may also be due to their wider host flower range. Although we have no evidence, in less abundant species there may be selective pressure to use the flowers of relatively few species of plants, to increase the opportunity of locating mates.

Although some species appear to switch from goatsbeard to wild hydrangea as soon as the latter appears (especially apparent in *M. vittata*) (Table 2), this does not actually occur. It is due to the different flowering phenologies through the four years of study. Both flower hosts are used by most lepturines when they are available. The only exception we found was *T. velutinus*. Even when goatsbeard was in bloom and numerous *T. velutinus* were present, we never saw individuals on flowers of this plant. In a typical year, adults of this species become abundant only after the peak flowering period of goatsbeard.

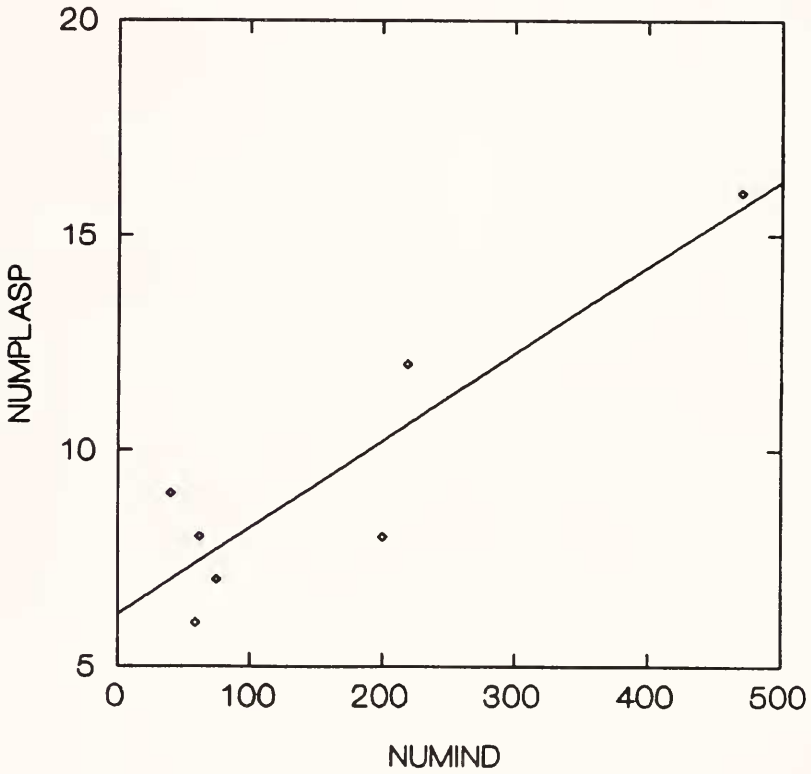

Fig. 1. Numbers of individuals of the seven most abundant lepturines compared to the number of species of plants (flowers) used.

The highest abundance of anthophilous cerambycids in Reas Run is slightly bimodal with a peak the third week of June and a second increase in mid-July. While the third week in June had the greatest species diversity, the high numbers in July were due mainly to the presence of just one species *T. velutinus*. Over the entire sampling period *T. velutinus* alone made up 30.8% of all individuals observed. *A. lineola, S. abbreviata* and two species of *Brachyleptura* were also quite abundant and accounted for an additional 49.4% of the observations. Four species, *Gaurotes cyanipennis* (Say), *Strophiona nitens* (Forster) (both Lepturinae), *Molorchus bimaculatus*, and *Rhopalophora longipes* (Cerambycinae) were only recorded once.

Both goatsbeard and wild hydrangea are used to a great extent by species of anthophilous Cerambycidae. The importance of this source of food may be critical for successful reproduction by these and other flower feeding

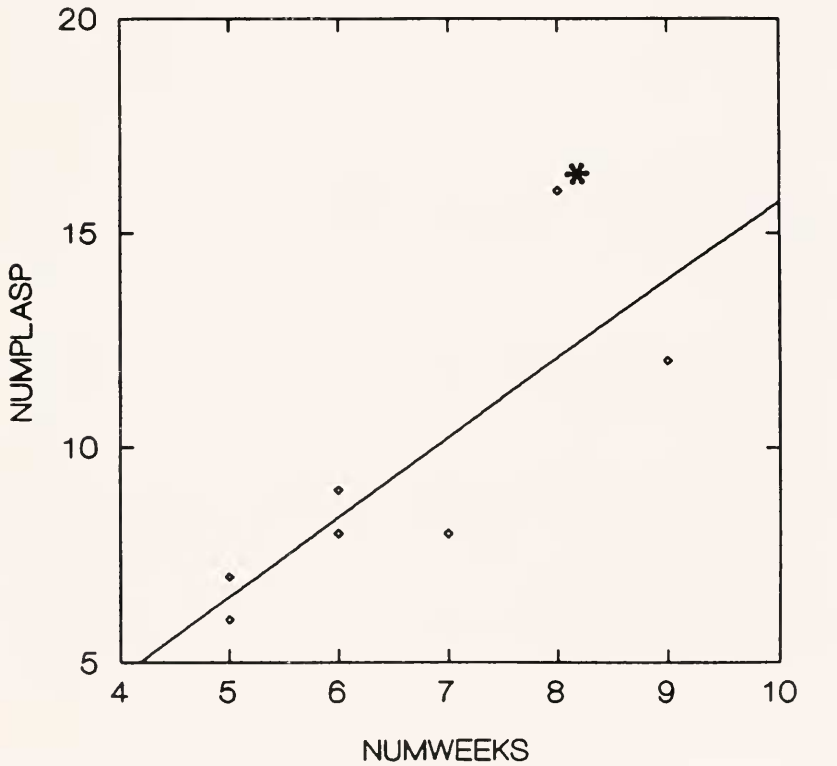

Fig. 2. Number of weeks of activity of the seven most abundant lepturines compared to the number of species of plants (flowers) used. Note that the period of activity of *Typocerus velutinus* (indicated by an *) has been increased by two weeks. See discussion for more details.

insect species. Roadside habitats adjacent to forests, where these flowering plant hosts are commonly found, should be protected from overzealous cutting and spraying by road maintenance crews.

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